**SESSION 4A BIO PRODUCTS & ENERGY**

**4A1 TMP of the future: challenges and strategies**
***Radia Ammara**, Sara Eskandarifar, Hakim Ghezzaz and Serge Bedard*, CanmetENERGY

With the decline of newsprint demand, and the rising demand for packaging material and tissue paper, Canadian TMP mills have to evaluate their potential to enter new markets and produce new products. In addition, Canada has committed to reducing greenhouse gases (GHG) emissions by 30% below 2005 levels, by 2030, while Canadian pulp and paper industry was responsible for 6.8 $MtCO_{2e}$ in 2016. In response to these challenges, TMP mills should explore different transformation avenues. The purpose of this work is to assess the strategies and the impacts of producing new products and entering new markets; identify potential process bottlenecks that the mill might encounter during transforming its production; and propose strategies and projects to address the different challenges. The strategies proposed in this work are in line with the long-term strategy of the mill, and will help to minimize the mills energy consumption and GHG emissions, which is in line with Canada's commitment to Paris agreement. The GHG abatement potential and costs of the proposed projects are investigated taking into account their initial capital cost, their impact on energy and power costs.

**4A2 Upgrading Turbine Generator Controls**
***Adrian Mazurek,** William Cheung,* Andritz

Many pulp and paper mills utilize cogeneration to provide both process and financial benefit to their operation. Significant reliability issues begin to arise as these complex systems begin to age. Since cogeneration systems began to be implemented, newer and more advanced technology became available in the realms of generator and turbine control and protection, and there is significant advantage to replace the aging systems. From both a technical and logistical standpoint, there are also many obstacles faced when engineering system upgrades of this scale. Scope of responsibility, justification and technical advantages of upgrading, interconnection and regulatory requirements, and general challenges faced with brownfield replacement of systems of this scale will be discussed.

**4A3** Biorefining **and Machine Learning: Towards a Universal Kinetic Model of Wood Deconstruction**
***Edward Wang***, UBC

Hemicellulose, or amorphous polysaccharides, is a major component of lignocellulosic biomass and can be hydrolyzed into monomers to support bio refining transformations. Hemicellulose hydrolysis has been studied extensively, yet there lacks a universal model of this process that can be applied to multiple species and reactor conditions. Most current models are based on Arrhenius type kinetics and are only effective when applied to the conditions under which the empirical parameters were fitted. An alternative to first principles kinetic models is to use a holistic data driven approach, specifically machine learning. In this project, the literature on hardwood hemicellulose hydrolysis is mined and used to build machine learning models. Ridge linear regression, support vector regression, and neural networks are examined. Predictions of xylose yield within 15% were obtained, but the effect of overfitting is still being examined.

**4A4 Mill digitalization from start-up to long-term optimization**
*Lars Almkvist*, Valmet

Digitalization is developing fast across industries and in the society in general. New technologies, such as advanced cloud simulators, internet of things and artificial intelligence, create new opportunities to support engineering and start-up of new pulp mills, as well as to improve mill performance and reliability. In this new

landscape, industries face multiple challenges adapting to not only new technologies but also new ways of making business.

A key to successful adaptation lies in building and maintaining required skills and expertise of the mill personnel. A modern, technology-enabled training concept, combining theory and practice, brings workers up to speed and supports continuous learning as mill technologies evolve. Competence mapping tools are helpful in determining initial competence levels before designing individual or role-based learning paths. Online equipment and process courses available 24/7 provide the theoretical foundations, which are reinforced by classroom sessions and procedure and scenario training using simulators.

In addition to getting operators ready to handle the plant before it is up and running, training simulators provide enhanced opportunities for verification of process design, testing of the DCS and evaluation of new control strategies. DCS and Advanced Process Control systems can be safely and thoroughly verified before start-up. All of these create a foundation in reaching a fast start-up. After start-up, online learning tools and training simulators support the personnel's continuous competence development as well as training of new employees, throughout the lifecycle of the mill.

Recent record-fast mill start-ups verify this. One example is the installation and start-up of the new continuous cooking plant in Irving Pulp & Paper, St John, Canada, which was running at nominal capacity already on the second day. Another example is the new white liquor plant in CMPC Laja, Chile, where a switch from the old to the new plant was made without stopping the mill's production.

Advanced Industrial Internet technologies provide new opportunities for long term mill optimization and support, through advanced analysis, controls, simulation tools and artificial intelligence functions. Combined with process, machinery and automation expertise, these solutions create a strong foundation for improved performance and reliability. Interesting results can already be shown both for pulp and paper mills.

**4A5 Use of NCG's to Produce Concentrated Sulphuric Acid and Steam**

***Rohan Bandekar,*** Noram Engineering, Vancouver

The pulp and paper industry often encounters challenges that require process improvements to remain competitive. These challenges may include the requirement to meet more stringent environmental regulations, stricter energy policies, or the need to improve product quality, increase production capacity and profitability. The current global market also provides new opportunities to a pulp mill beyond the traditional products portfolio.

Recovering lignin from Kraft black liquor has become an attractive option using the LignoForce SystemTM, which is a process developed and implemented by Canada's NORAM Engineering and FPInnovations. This process consumes sulphuric acid and therefore the combination of a lignin recovery system with an on-site sulphuric acid production plant brings economic and environmental benefits. NORAM's expertise in sulphuric acid manufacture is widely recognized around the world and NORAM's sulphuric acid technologies are well-suited to produce commercial grade sulphuric acid (98.5% w/w) and superheated steam from non-condensable gases (NCGs).

This paper provides an overview of the technology required to produce sulphuric acid in a pulp mill from NCGs, presents some of the unique challenges related to feed variability, and discusses some of the technical features of NORAM's sulphuric acid process technology and equipment.